

REMARKS

Claims 24-37, 40-51 and 57-68 are in this application. Claims 24, 26, 28, 32, 33, 34, 35, 36, 37, 48, 50 and 51 have been amended. Claims 38 and 39 have been cancelled.

According to the Official Action, claims 24-51 are rejected under 35 USC 112, first paragraph as not being enabled because of the inclusion in claims 24 and 51 of the phrase "heating for conducting a subsequent reaction so as to increase the numbers of isocyanate functional groups contained in said composition." This is respectfully traversed and if necessary, an explanation of how these claims are enabled will be provided. However, to expedite prosecution of this application, claims 24 and 51 have been amended to delete this phrase.

Therefore, it is respectfully requested that this rejection be withdrawn.

According to the Official Action, claims 24-51 and 57-66 are rejected under 35 USC 112, second paragraph as being indefinite because a) of the phrase "molecular weight in" claims 32-34.. This is respectfully traversed.

Persons having ordinary skill in the technical field would appreciate that unless otherwise specified, the expression "molecular weight" in regard to polymers, polyether monoamines or polyether diamines should refer to "number-averaged molecular weight." Therefore, the molecular weight in Claims 32, 33, and 34 has been specified as "number-averaged molecular weight." A typical example is the number-averaged molecular weight of JEFFAMINE® series that is described in paragraph [00019] of the specification.

Therefore, it is respectfully requested that the rejection be withdrawn.

b) The Examiner has rejected claims 38-39 because they recite trade names. These claims have been cancelled and therefore, the rejection is moot.

It is noted that the polyether monoamines sold under the trade names such as JEFFAMINE® M-1000 and JEFFAMINE® M-2070 and polyether diamines sold in the trade names such as JEFFAMINE® ED-600, JEFFAMINE® ED-900, JEFFAMINE®

ED-2001, and JEFFAMINE® ED-2003 are frequently used in the art. If desired, persons having ordinary skill in the technical field to which the present invention belongs may acquire a product list from Huntsman company to have a better understanding of the details of these commercial products, such as their structural formulae, constitutions, and number-averaged molecular weights. Thus, the applicant does not agree with the examiner's assertion that these trade names render the scope of the claims of the subject application indefinite.

c) The Examiner states that the phrase "heating for conducting a subsequent reaction so as to increase the numbers of isocyanate functional groups contained is said composition" is unclear. In view of the cancellation of this phrase from claims 24 and 51 this is moot.

However, the applicants want to bring to the Examiner's attention that after converting a part of urea at elevated temperature, the NCO contents of the reaction mixture actually decrease, while the NCO functionalities of the hydrophilic oligomers increase.

According to the Official Action, claims 24-51 and 57-66 are rejected under 35 USC 102(b) as being anticipated by US patent 5,202,377 (Thorne et al.) and claims 24-25, 30-48 and 57-66 are rejected as being obvious over this reference. These rejections are respectfully traversed.

Claims 24 and 51 have been amended to define that the aliphatic polyisocyanate has primary and secondary isocyanate. This serves to distinguish the claims from US patent 5,202,377. Support for this amendment can be found in paragraph [00014] of the specification and the originally filed Claims 27 and 28, wherein certain species of aliphatic polyisocyanates having primary and secondary isocyanate have been disclosed.

The major differences between the patent and the present invention are summarized in Table 1 below.

In Claim 1 of the '377 patent, a polyisocyanate mixture (PM) comprises:

- (i) an isocyanate (NCO) functional oligomer, which is the reaction product of:
 - (a) a polyisocyanate (polyNCO) having tertiary isocyanate groups (3°-NCO), and

(b) a hydrophilic polyether having a group which will react with tertiary isocyanate groups (3°-NCO), and

(ii) a polyisocyanate having tertiary isocyanate groups (3°-NCO).

'377 PATENT teaches that the reaction of polyNCO having 3°-NCO with a hydrophilic polyether monol (preferred) or mono-amine can be carried out at $20\text{-}80^\circ\text{C}$ for 30 min ~ 4h (see '377 PATENT, column 4, lines 42-44), optionally with some catalyst. Anyone who is skilled in the art well knows that:

"the exothermic reaction of NCO with amine ($-\text{NH}_2$) to form urea (NHCONH) is ready at ambient temperature without catalyst, but gelation or high viscosity product would occur when a proper solvent is absent."

In addition, the product viscosity is also related to the content of polar groups. As listed in Table 2, the major polyNCO used in '377 PATENT is TMXDI-TMP urethane adduct, which is full of strong polar urethane groups and sticky (Cythane 3160, solid content 80%, 3,000-6,000 cP/ 25°C). Despite the exotherm of urea formation, the interaction between urethane and the formed urea would obviously increase the PM viscosity. In general, hydrogen bonding between strong polar groups can be broken by (1) enough quantity of a proper solvent, and/or (2) mild heating. The two means basically maintain the chemical structure, but reduce the intermolecular interactions so as to avoid the physical crosslinking between molecules. It is apparent that, the examples of '377 PATENT use some high polar (also high b.p.) solvent, *N-methyl pyrrolidine (NMP)* (ca. 15-20 wt% of the hydrophilic oligomer solution as a whole), and *mild heating ($40\text{-}60^\circ\text{C}$) within 1h* to prevent the formation of gel in making the said NCO functional oligomer. '377 PATENT also mentions that the catalyst can be used to accelerate the reaction between the polyNCO and the hydrophilic polyether ('377 PATENT, column 4, line 45-47), and in the examples (1.1, 1.5, 2.4, 2.5, and 2.6) the catalyst, dibutyl tin dilaurate, is only used to promote the reaction of 3°-NCO and the preferred poly(ethylene oxide) monol at 50°C for 3h. Anyone who is skilled in the art knows such reaction needs catalyst because of the poor reactivity of 3°-NCO toward alcohol. Consequently, the catalyst used in '377 PATENT should be limited for the reaction of 3°-NCO with hydrophilic polyether monol. Even if the catalyst is added in the reaction of 3°-NCO with hydrophilic polyether mono-amine at 80°C for 4 h (the upper limit of reaction condition mentioned in '377 PATENT), biuret will not be easily generated because of the obvious steric hindrance of 3°-NCO .

Although the comparative example 1.3 of '377 PATENT uses raw materials similar to that appear in the present invention, the inventors of the subject case have adopted *strong heat treatment at $100\text{-}150^\circ\text{C}$ for several hours, especially without any solvent*, (see new claim 67) to not only break up the hydrogen bonding caused by urea, but also to convert a part of urea into urea derivatives, such as biuret, triuret, tetrauret, etc., according to the synthetic concept of biuret-based hydrophobic polyNCO in US 3,903,126. Examples provided in the specification and the attachments in the reply to the first OA, such as (1) the drop in NCO content, (2) the change in PM viscosity, and (3) the

GPC peak area variation, and (4) the ^{13}C -NMR analysis, all show that the *excess isocyanate (1°-NCO and/or 2°-NCO) can react with the urea* (formed at ambient temperature) in the strong heat treatment. Consequently, the solvent-free 100% non-volatile water-dispersible polyisocyanates (WDPIs) compositions bearing urea and urea derivatives can be prepared by the process.

So far, it is clear that the WDPI compositions (or chemical structures) are different from those in '377 PATENT, and therefore the present invention should be novel. In addition, the process can be conducted in the absence of solvent and yield 100% non-volatile hydrophilic polyNCO, which is industrially favored and unable to be achieved by the teaching of '377 PATENT. Accordingly, this invention should also be non-obvious.

As described in Table 1, the hydrophilic polyether utilized in US patent 5,202,377 is either monol or monamine. See column 4, line 12 of the patent.

Table 1 Difference of polyisocyanate mixture

Comparison	US 5,202,377 ('377 PATENT)	Appl 10/724,923
Type of polyNCO	3°-NCO (TMXDI urethane adduct)	1°-NCO and/or 2°-NCO (HDI/IPDI isocyanurate trimer)
Hydrophilic polyether	(1) Monol (preferred) (2) Mono-amine	(1) Mono-amine, di-amine, tri-amine. (2) mixture of amine with alcohol (monol, diol, triol)
Reaction temperature and time	At 20-80°C for 30 min - 4h.	Initially at ambient temperature, and then at 100-150°C for 2-8h*
Catalyst	Optional (especially for polyether monol)	Not necessary
Linkage between hydrophobic polyNCO and hydrophilic polyether	(1) urethane (2) urea	(1) urea/urea derivatives (biuret, triuret, tetrauret, etc)* (2) urea/urea derivatives* and urethane
Ideal NCO functionality of the hydrophilic oligomer for dispersing	2	Depending on the hydrophilic polyether and the derived linkages: (1) mono-amine a. urea: 2

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- b. biuret: 4
 - (2)di-amine
 - a. bis-urea: 4
 - b. mono-urea/biuret: 6
 - c. bis-biuret: 8
 - (3)monol: 2
 - (4)diol: 4
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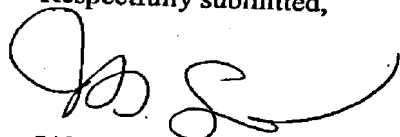
* According to US 3,903,126.

Table 2 The recipe of relevant examples in US 5,202,377

US 5,202,377 ('377 PATENT)			
Comparison Item	Example 1, 2 NCO oligomer 2	Example 1, 3 NCO oligomer 3 (For comparison)	Example 1, 4 NCO oligomer 4
Raw materials:			
PolyNCO	3°-NCO (TMXDI-TMP adduct 80% solid in MEK/ BAC)	1°-NCO (HDI isocyanurate trimer 90% solid)	3°-NCO (TMXDI-TMP adduct 80% solid in MEK/ BAC)
Hydrophilic polyether	Mono-amine (M-1000)	Mono-amine (M-1000)	Mono-amine (M-2070)
NMP	Used	Used	Used
Catalyst T-12*	No	No	No
Process:			
	1. Pre-heat to 40°C. 2. Add M-1000 and maintain the reaction temperature at 40°C. 3. Stir at 25°C for 1h.	1. Pre-heat to 55°C. 2. Add M-1000 at 55°C over 3 min with stirring. 3. Stir at 55°C for 25 min and then cool.	1. Slowly add M- 2070. 2. Stir at ambient temperature for 30 min.
Solid content	ca. 75%	ca. 75%	ca. 75%

* T-12 = dibutyl tin dilaurate

Respectfully submitted,



JANET I. CORD
LADAS & PARRY LLP
26 WEST 61ST STREET
NEW YORK, NEW YORK 10023
REG. NO.33778 (212)708-1935